The U.S. Drought Monitor: Percentiles, Parameters, People, Process, Policy and Possibilities

Mark Svoboda, Climatologist
Monitoring Program Area Leader
(With input from all USDM Authors!)

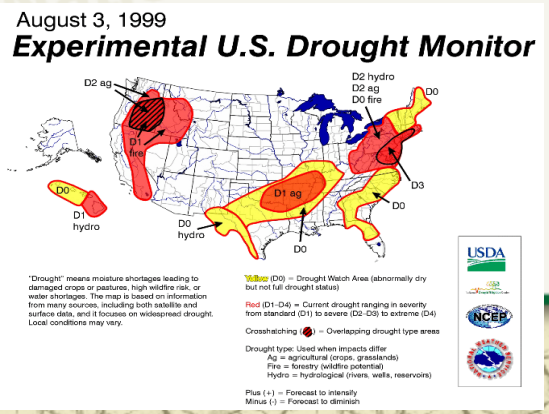
National Drought Mitigation Center
School of Natural Resources
University of Nebraska-Lincoln

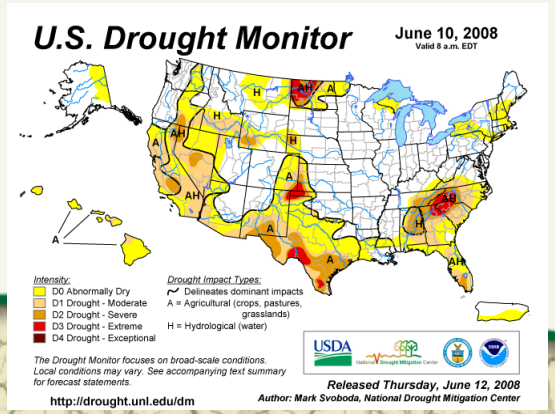
2016 Pacific NW NIDIS RDEWS Meeting, Portland, OR
February 2 –3, 2016

The U.S. Drought Monitor

Since 1999, NOAA (CPC, NCDC, WRCC), USDA, and the NDMC have produced a weekly composite drought map -- the U.S. Drought Monitor -- with input from numerous federal and non-federal agencies

- **Western Region Climate Center on board 2008**
- **11 authors in all**
- **Incorporate relevant information and products from all entities (and levels of government) dealing with drought (RCC's, SC's, federal/state agencies, etc.) *(350+ experts)***





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Requirement: Authors must work at a regional or national "center", government or academia/research

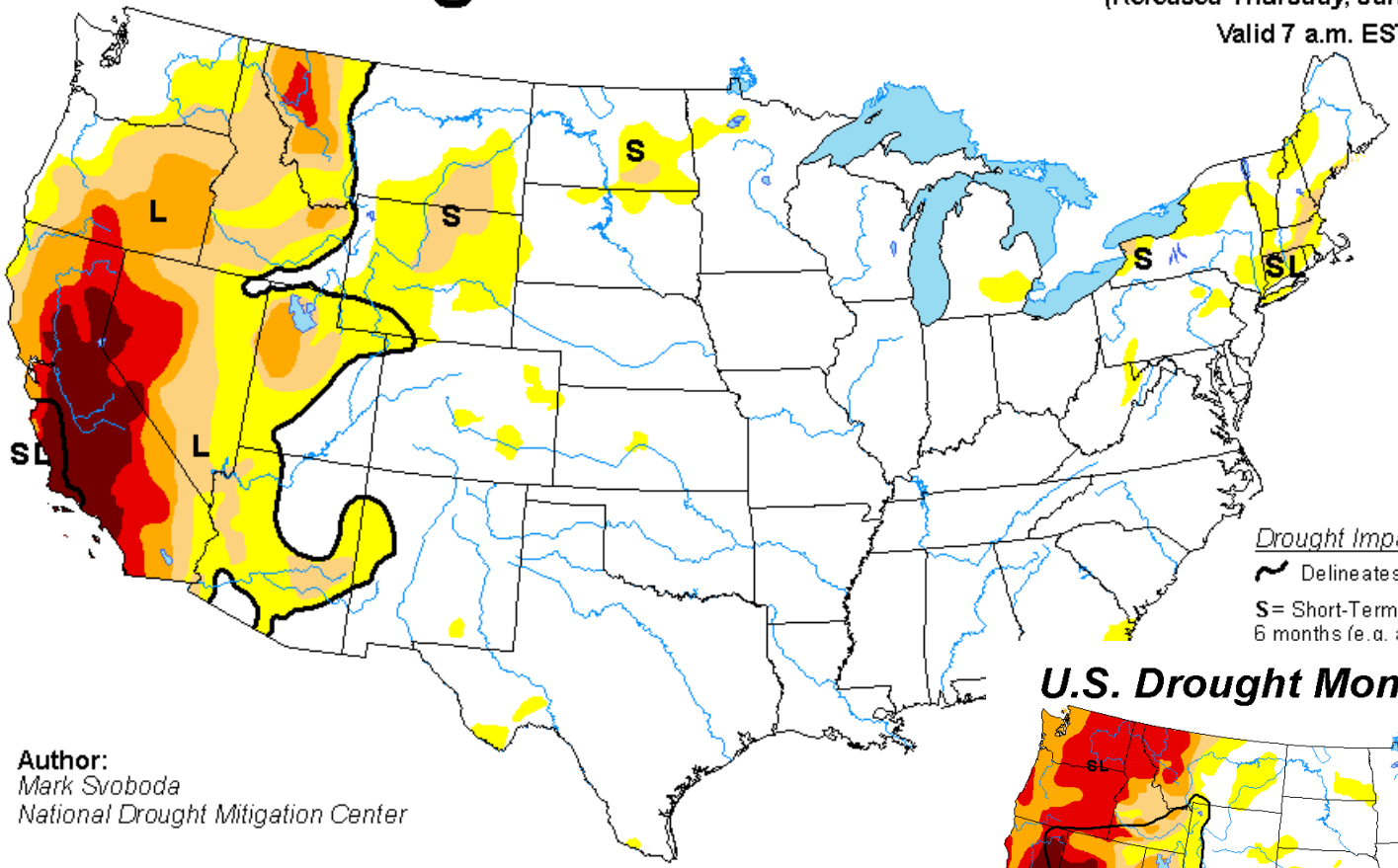
There are currently 11 authors, and all are volunteers

U.S. Drought Monitor

January 26, 2016

(Released Thursday, Jan. 28, 2016)

Valid 7 a.m. EST

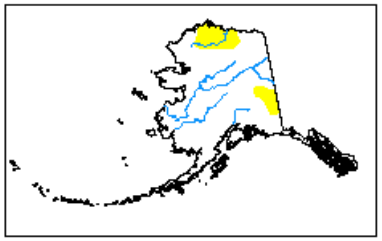


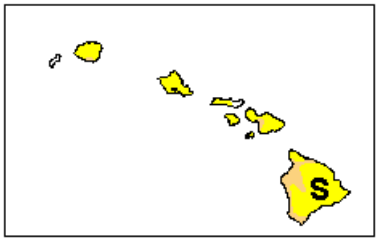
Drought Impact Types:

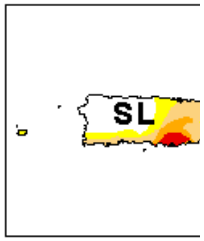
~ Delineates dominant impacts

S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

Author:
Mark Svoboda
National Drought Mitigation Center





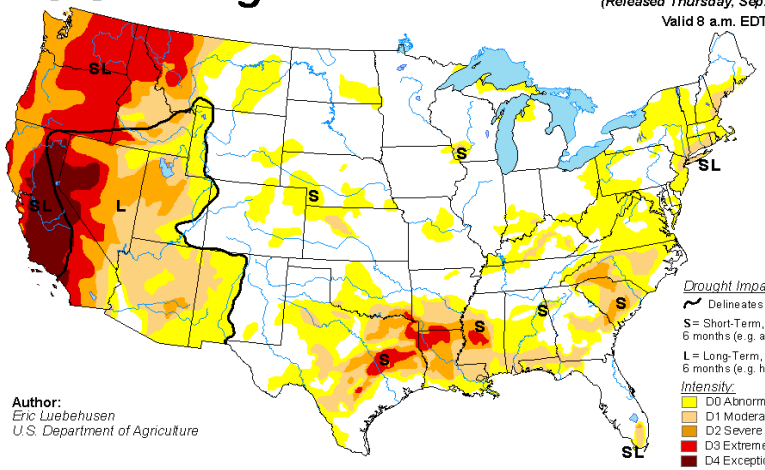


U.S. Drought Monitor

September 22, 2015

(Released Thursday, Sep. 24, 2015)

Valid 8 a.m. EDT



Drought Impact Types:

~ Delineates dominant impacts

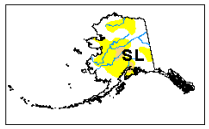
S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

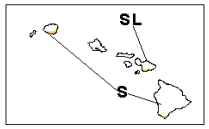
L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

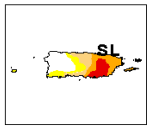
Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

Author:
Eric Luebehusen
U.S. Department of Agriculture





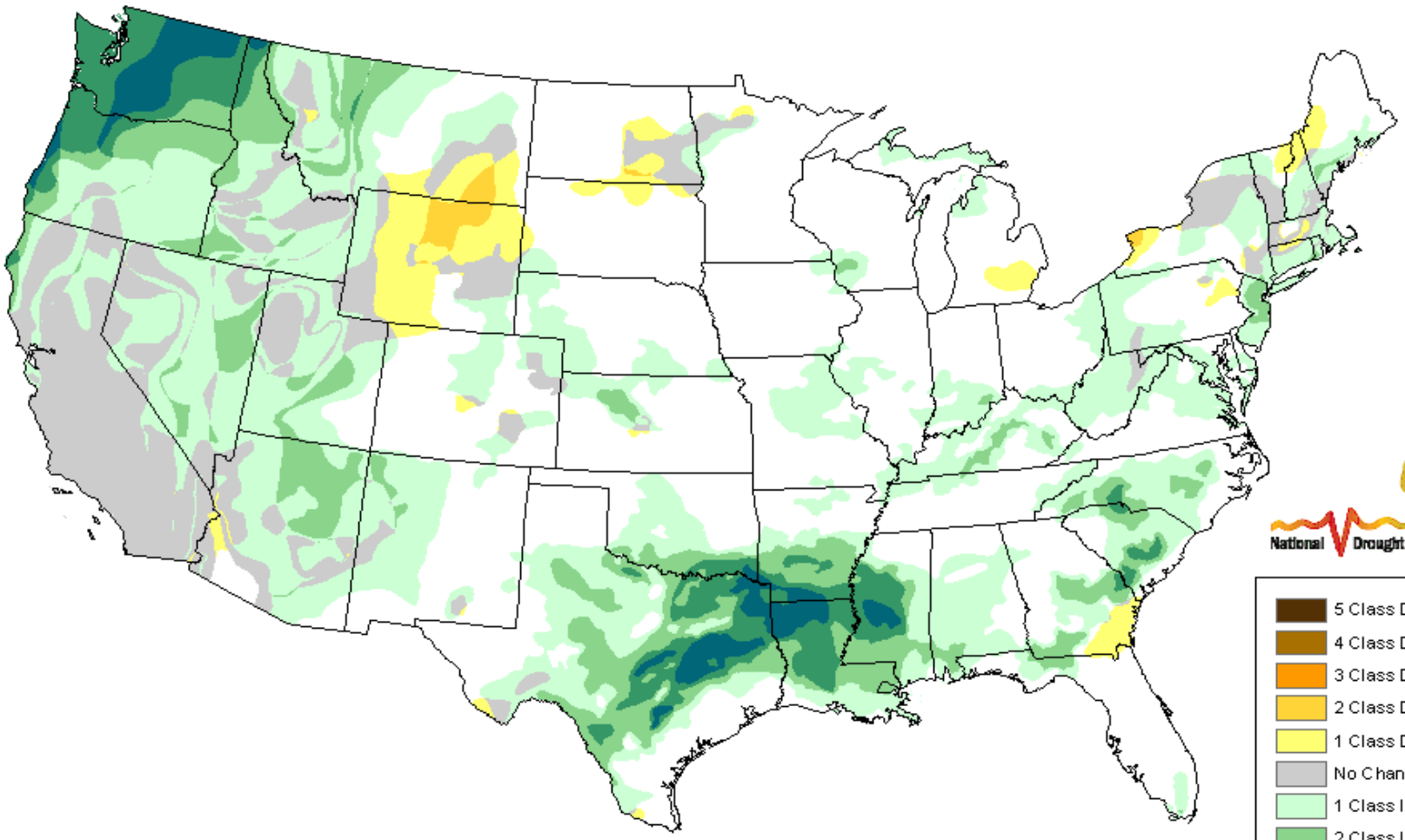


The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu/

U.S. Drought Monitor Class Change

Start of Water Year



National Drought Mitigation Center

- 5 Class Degradation
- 4 Class Degradation
- 3 Class Degradation
- 2 Class Degradation
- 1 Class Degradation
- No Change
- 1 Class Improvement
- 2 Class Improvement
- 3 Class Improvement
- 4 Class Improvement
- 5 Class Improvement

January 26, 2016
compared to
September 29, 2015

http://droughtmonitor.unl.edu

Objectives

- Communication/awareness tool
- Assessment of **current** conditions
  - Primarily an ***"unmanaged"*** system approach
- ***NOT*** a forecast or drought declaration
  - Is used as a declaration trigger though
- Identify **impacts** (S, L)
- Incorporate **local expert** input
- Use an **objective** percentile approach
- ***"Convergence of evidence"*** approach

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PERCENTILES

Percentiles and the U.S. Drought Monitor

Advantages of percentiles:

- Can be applied to any parameter

The drought categories are associated with historical occurrence/likelihood (percentile ranking)

It is not anecdotal or subjective, like "It's really, really dry!!" ….or, "I don't remember it ever being this dry, we have to be D4!!"

- D4, Exceptional Drought:  1 in 50+ years **(2 %tile)**
- D3, Extreme Drought:  1 in 20 to 50 years **(5)**
- D2, Severe Drought:  1 in 10 to 20 years **(10)**
- D1, Moderate Drought:  1 in 5 to 10 years **(20)**
- D0, Abnormally Dry:  1 in 3 to 5 years **(30)**

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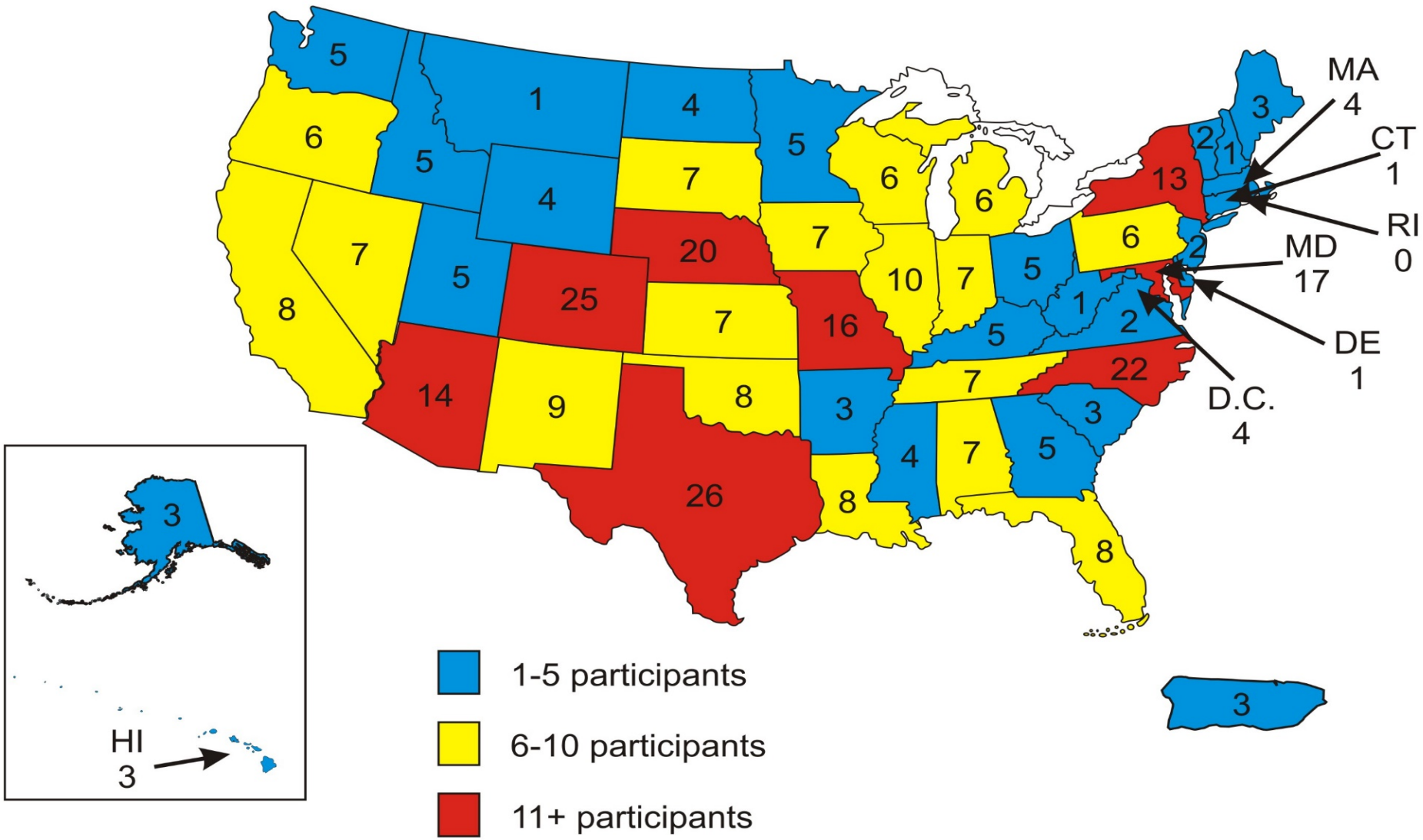
PEOPLE

USDM Listserve Subscribers

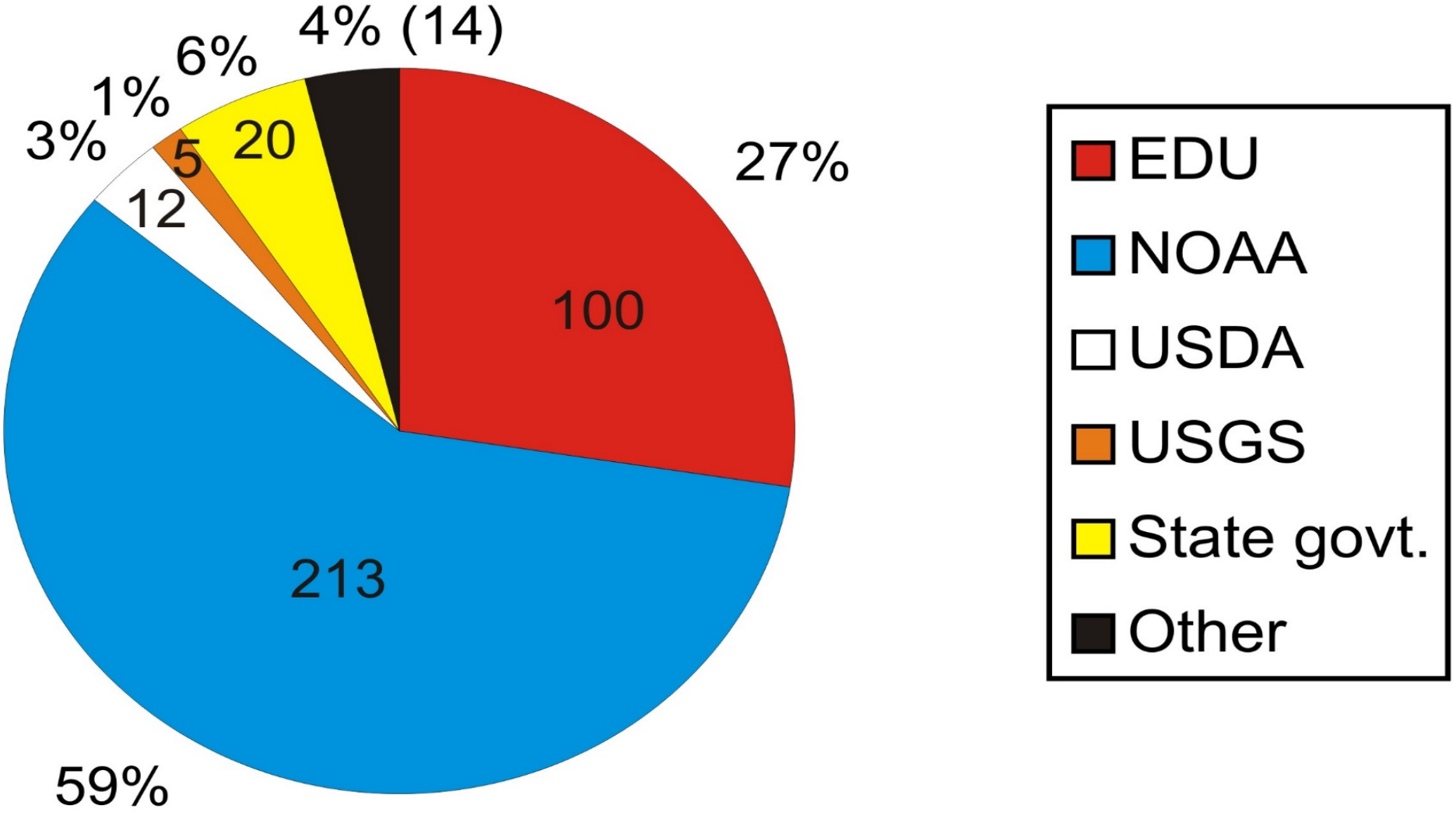
(as of August 20, 2015)



Total: 361 (does not include 1 participant from Canada and 2 participants from Brazil)

USDM Listserve Subscribers

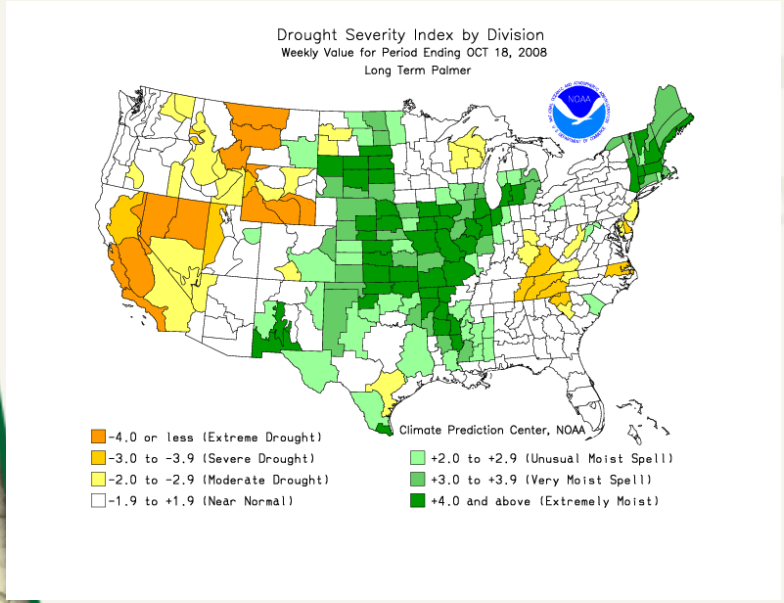
(as of August 20, 2015)

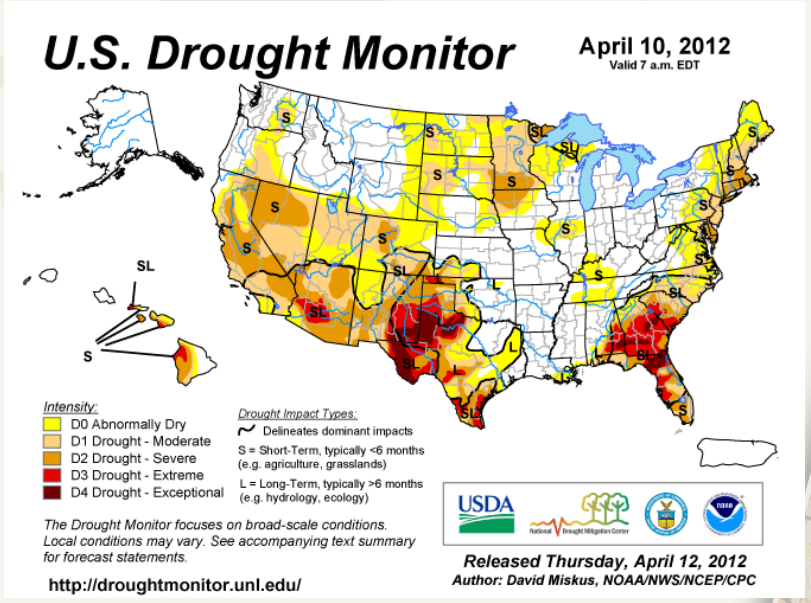


PROCESS

Approaches to Drought Assessment

- Single index or indicator (parameter)
- Multiple indices or indicators
- *Composite (or "hybrid") Indicator*





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USDM Approach

- **"Convergence of Evidence"**
  - Many types of drought "information" can be collectively analyzed to ***determine if the majority of information is 'converging' (telling the same story)*** about the accuracy, or inaccuracy, of the drought as depicted by the USDM
  - Need to ***look at 100% of the data, BUT don't believe in any one piece of data input 100%*** in making a decision…
  - ***Multiple indicators and types of information*** that describe different hydroclimatic parameters are needed to get a complete picture of a drought indicator's performance
  - ***Impacts are the "ground truth"***, yet aren't monitored….you can't measure what you don't monitor!

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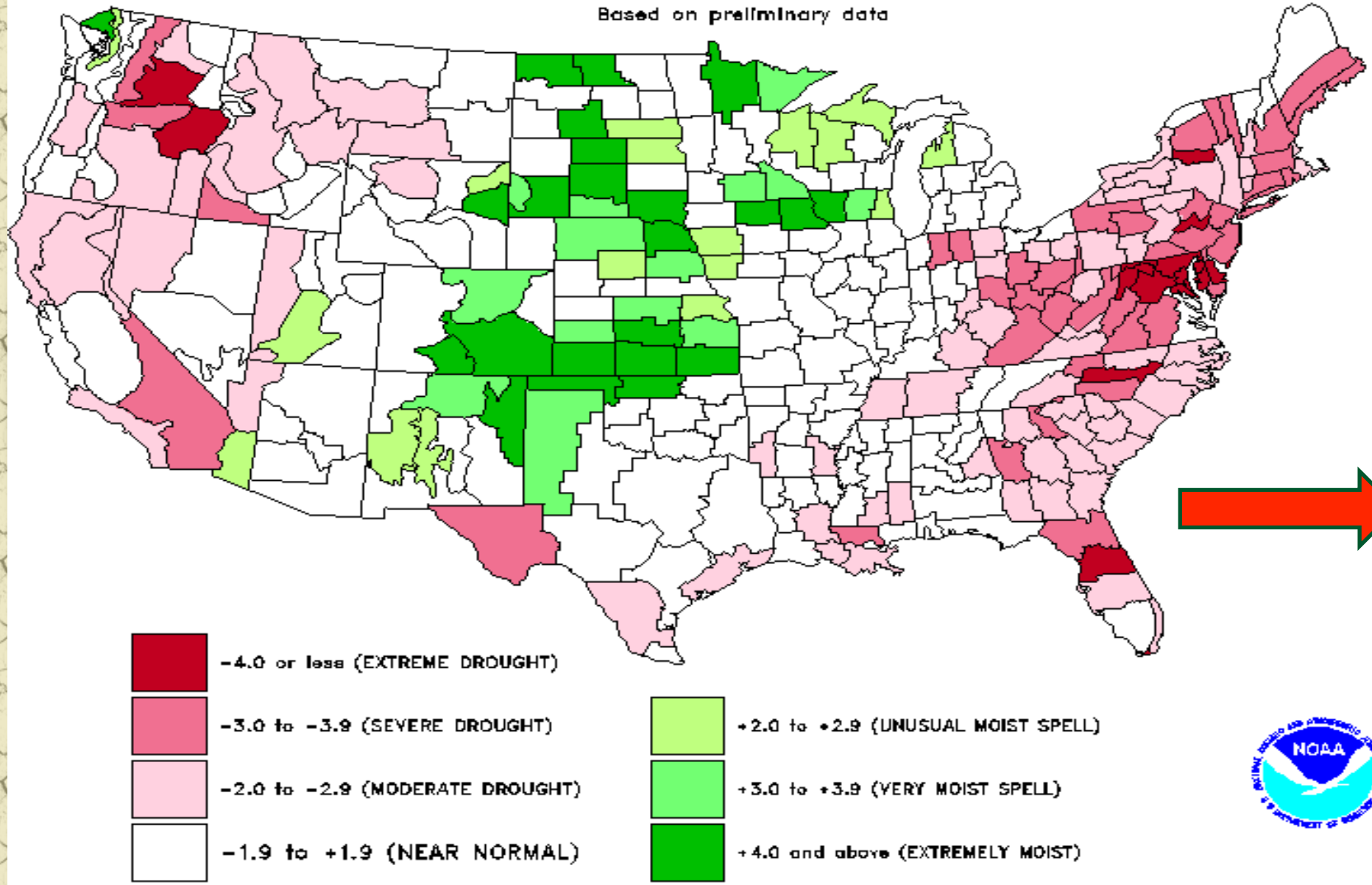
DROUGHT SEVERITY INDEX BY DIVISION

(LONG TERM PALMER)

AUG 7, 1999

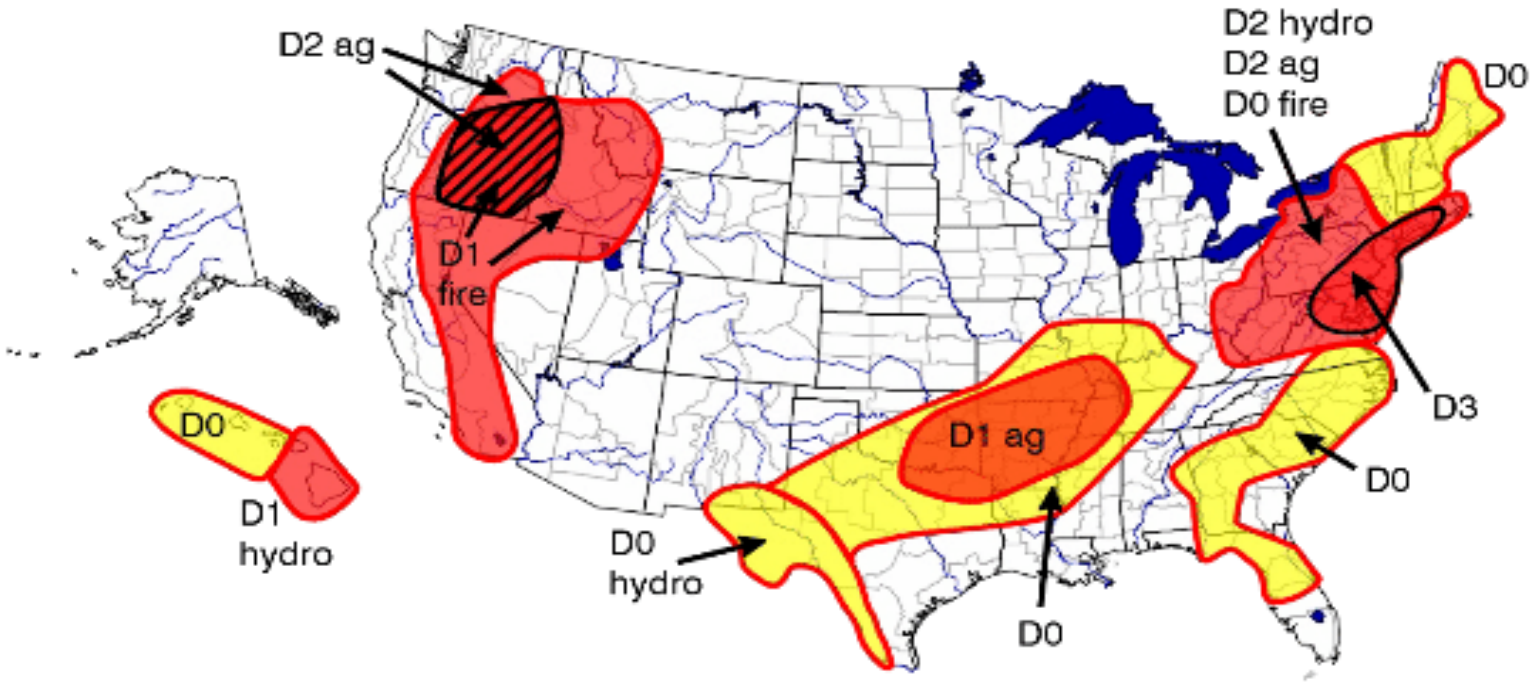
Based on preliminary data



CLIMATE PREDICTION CENTER, NOAA

August 3, 1999

Experimental U.S. Drought Monitor



"Drought" means moisture shortages leading to damaged crops or pastures, high wildfire risk, or water shortages. The map is based on information from many sources, including both satellite and surface data, and it focuses on widespread drought. Local conditions may vary.

Yellow (D0) = Drought Watch Area (abnormally dry but not full drought status)

Red (D1–D4) = Current drought ranging in severity from standard (D1) to severe (D2–D3) to extreme (D4)

Crosshatching (▨) = Overlapping drought type areas

Drought type: Used when impacts differ
- Ag = agricultural (crops, grasslands)
- Fire = forestry (wildfire potential)
- Hydro = hydrological (rivers, wells, reservoirs)

Plus (+) = Forecast to intensify
Minus (-) = Forecast to diminish

USDA

NCEP

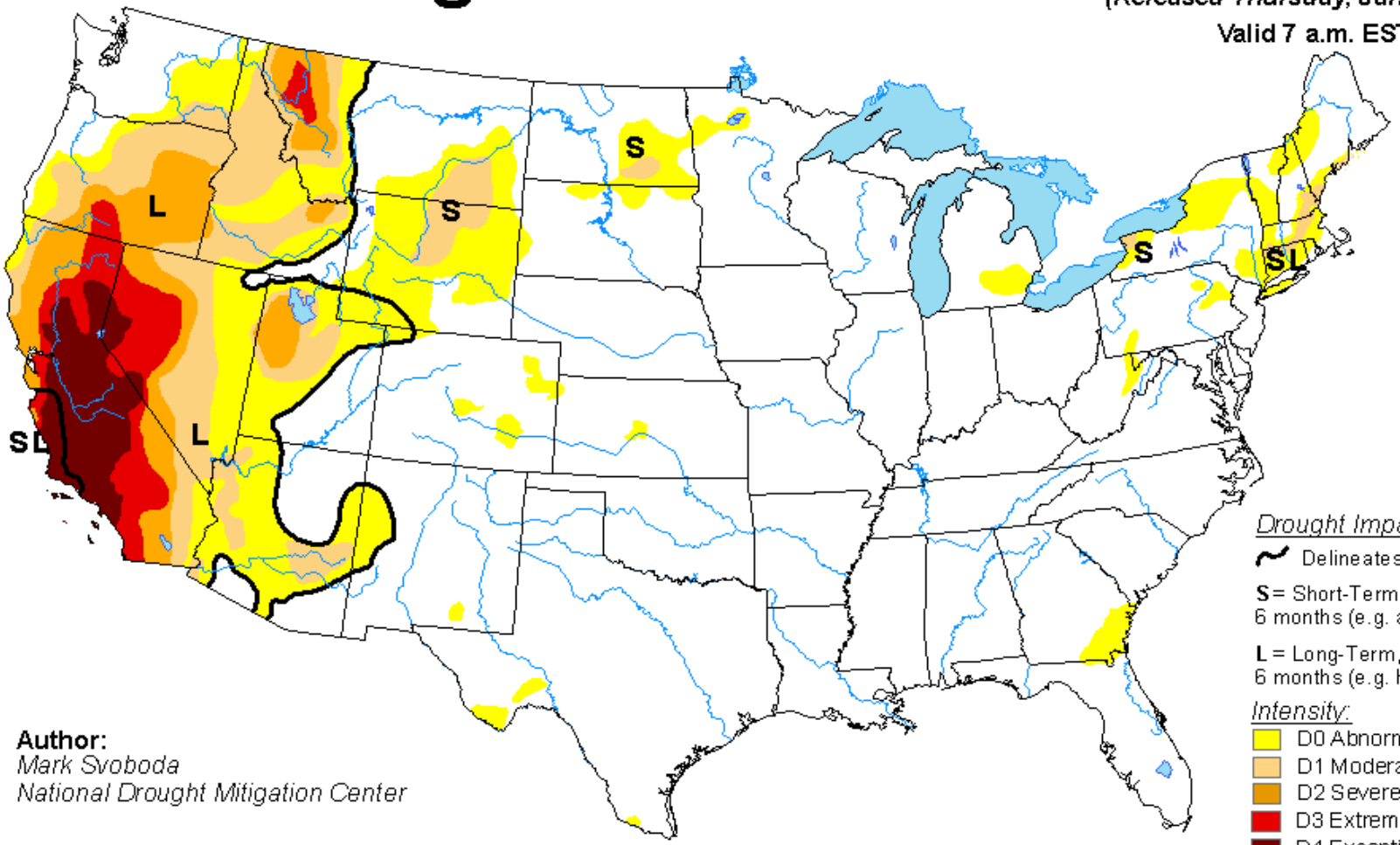
NATIONAL WEATHER SERVICE

U.S. Drought Monitor

January 26, 2016

(Released Thursday, Jan. 28, 2016)

Valid 7 a.m. EST



Author:
Mark Svoboda
National Drought Mitigation Center

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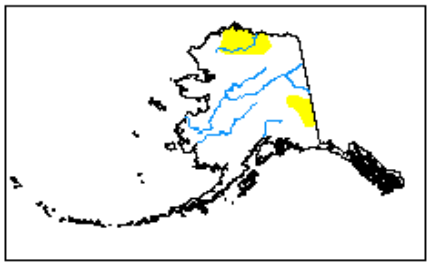

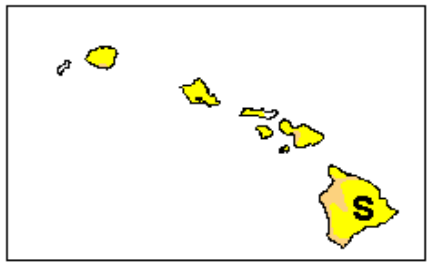

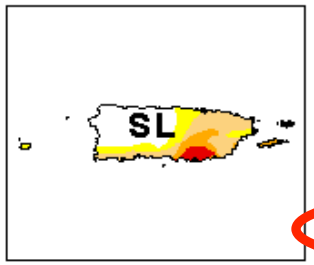

USDA

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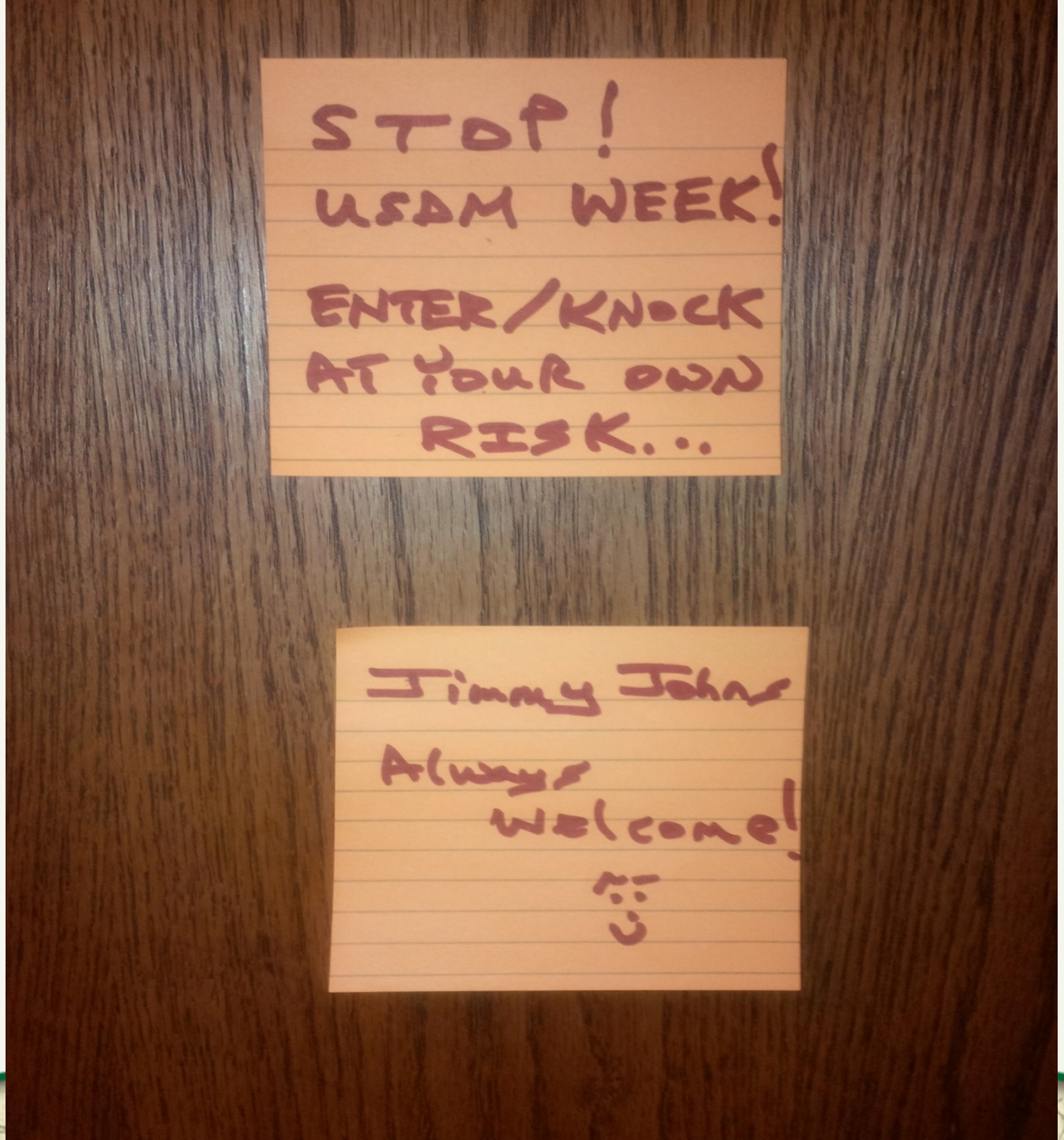
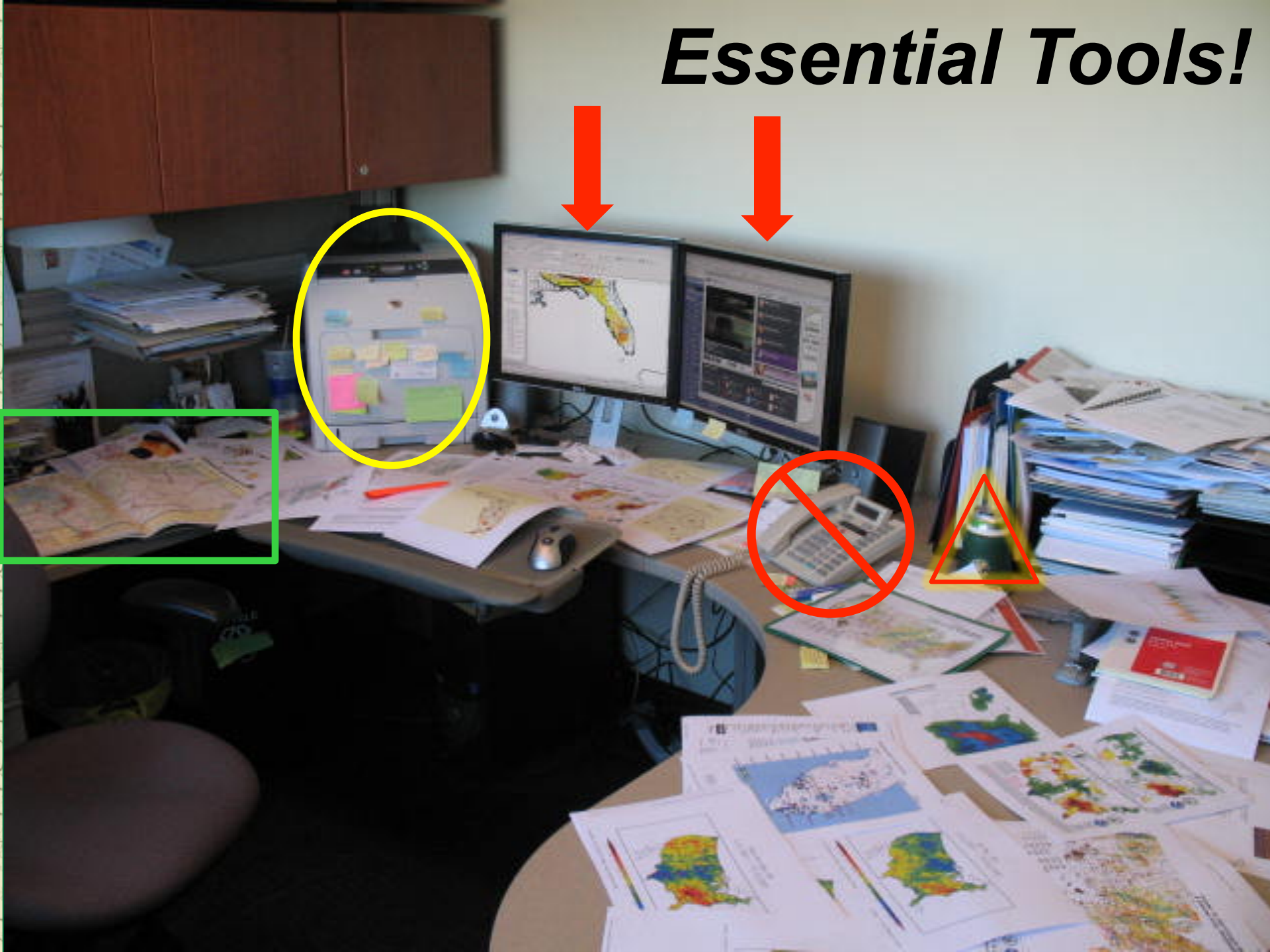

STOP!
USDM WEEK!
ENTER/KNOCK
AT YOUR OWN
RISK...
Jimmy Johns
Always
Welcome!
:-
:)


Essential Tools!

Regional + Local Feedback/Input Process

- Annual User **Feedback Forums** (USDM/NADM) since 2000
- Various webinars/telecons/reports/data/products
- ***Regional Climate Centers*** and *NOAA* **Regional Climate Service Directors and Coordinators along w/ Weather Forecast Offices (WFOs)**
- ***State Climatologists***
- ***Navajo and Wind River Tribes***
- ***CoCoRaHS (impacts!)***
- National Integrated Drought Information System ***(NIDIS) Pilot RDEWS*** basin webinars:
  - UCRB (Upper Colorado River Basin)
  - ACF (Apalachicola-Chattahoochee-Flint)
  - Southern Plains
  - MORB (Missouri River Basin/Central Region)
- ***State Drought Task Forces***: North Carolina, Hawaii, Oklahoma, Texas, New Mexico, Alabama, Florida, South Dakota, Kentucky, Arizona, Montana, Washington, Oregon and California/Nevada

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USDM/NADM Annual Forums

- Lincoln, NE, November 2000
- Asheville, NC, April 2002
- NADM, Asheville, June 2003
- Cedar City, UT, October 2003
- NADM, Regina, SK, October 2004
- Washington, D.C., October 2005
- NADM, Mexico City, October 2006
- Portland, OR, October 2007
- NADM, Ottawa, October 2008
- Austin, TX, October 2009
- NADM, Asheville, April 2010
- Washington, D.C., April 2011
- NADM, Cancun, Mexico, April 2012
- West Palm Beach, FL, Spring 2013
- NADM, Toronto, Canada, 2014
- Reno, NV, Spring 2015
- NADM, Ft. Worth, TX, June 2016

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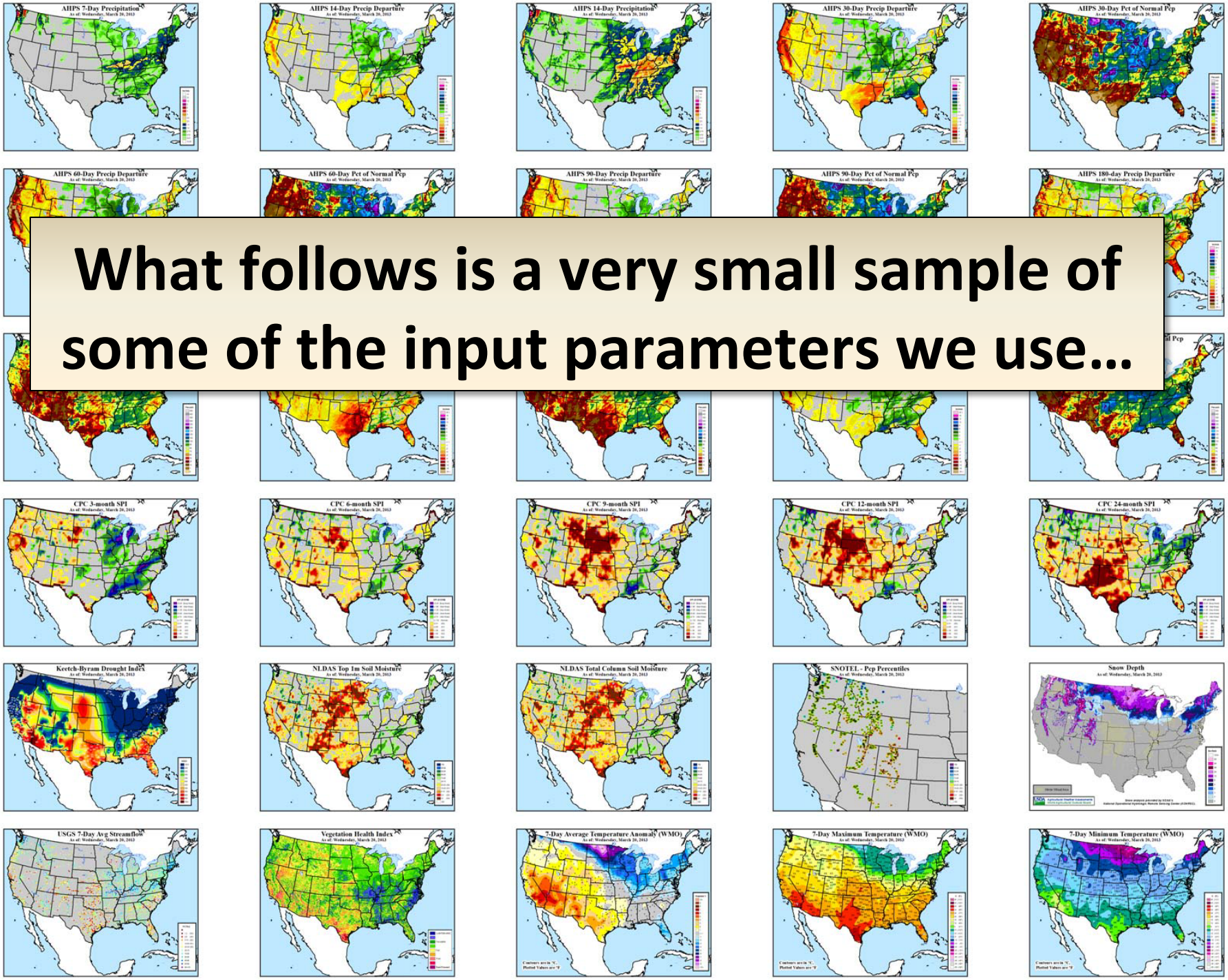
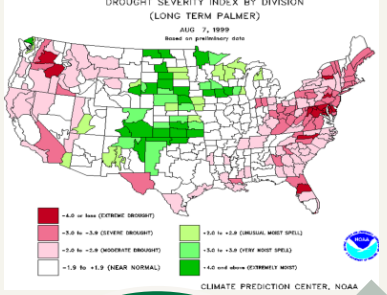
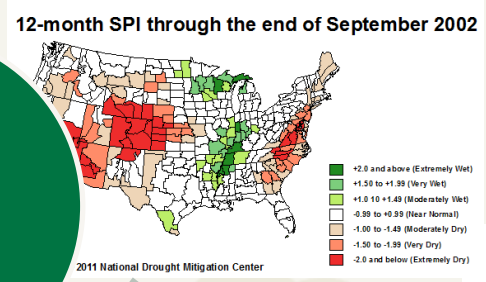
PARAMETERS

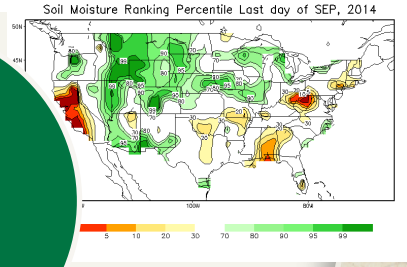


What follows is a very small sample of some of the input parameters we use…

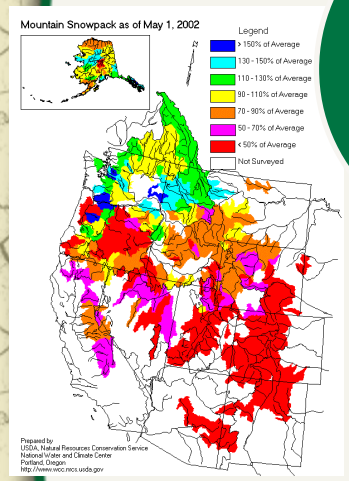




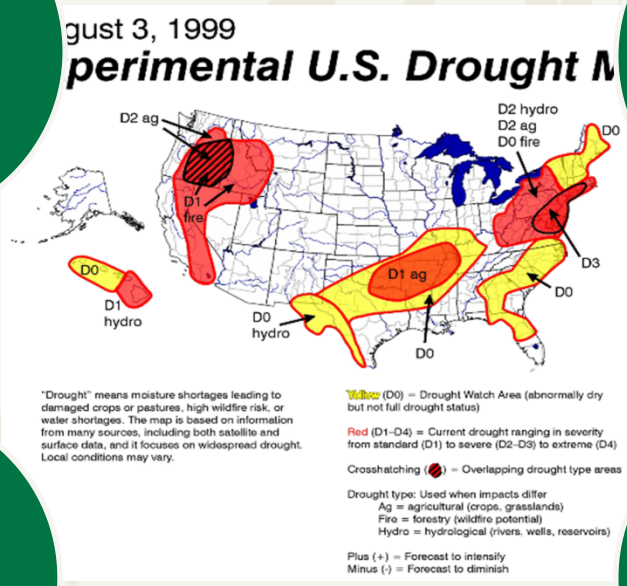
Indices: SPI/PDSI

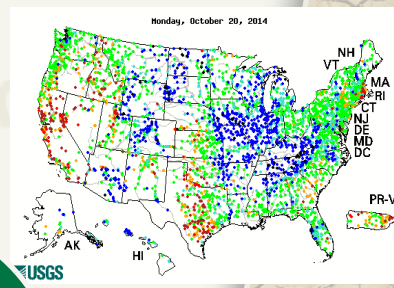


Soil Moisture



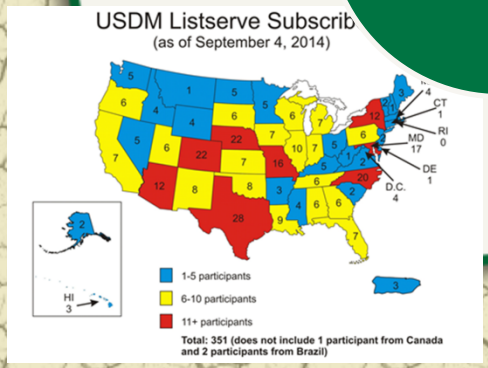
Snow



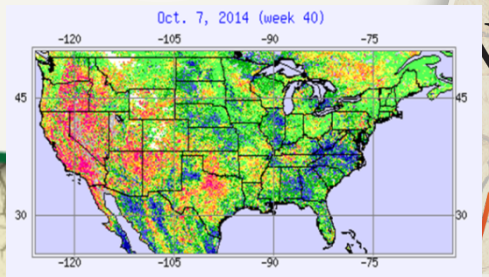


Expert Local Input

Streamflow



Remote Sensing



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U.S. Drought Monitor

Integrates Key Drought Indicators:

- Palmer Drought Index
- SPI
- KBDI
- Modeled Soil Moisture
  - NLDAS
- 7-Day Avg. Streamflow
- Precipitation Anomalies

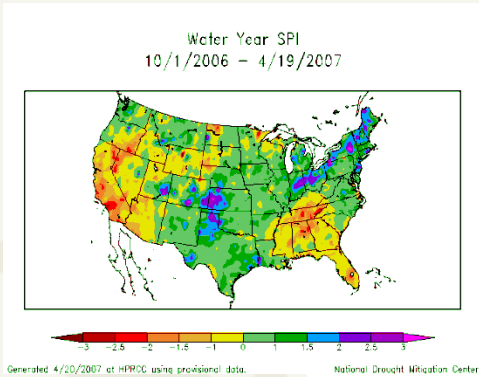
Growing Season:

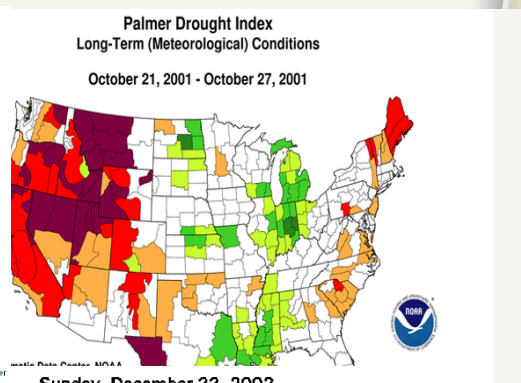
- Crop Moisture Index
- Sat. Veg. Health Index
- VegDRI/ESI/etc.
- Soil Moisture
- Mesonets
- State/Regional

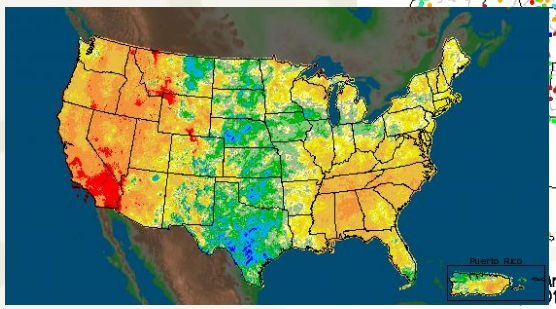
In The West:

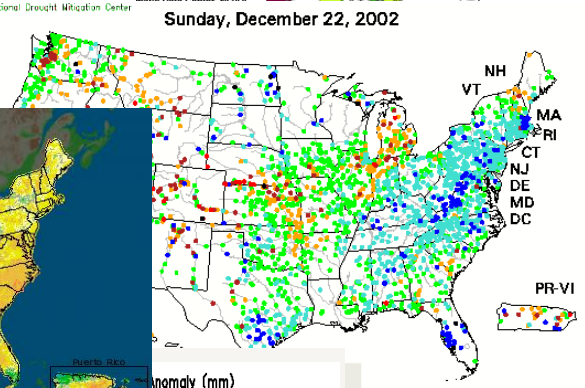
- SWSI
- Reservoir levels
- Snowpack (SNOTEL)
- SWE
- Streamflow

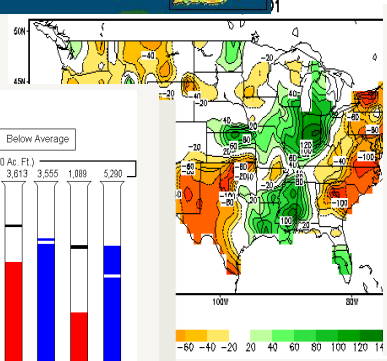
Created in ArcGIS

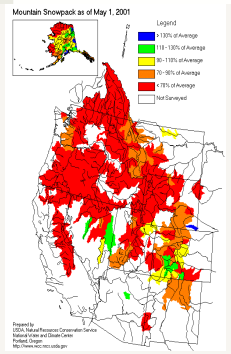


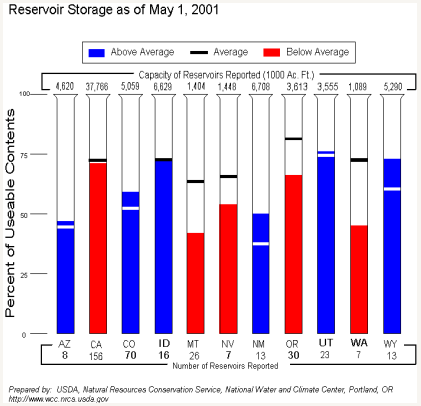




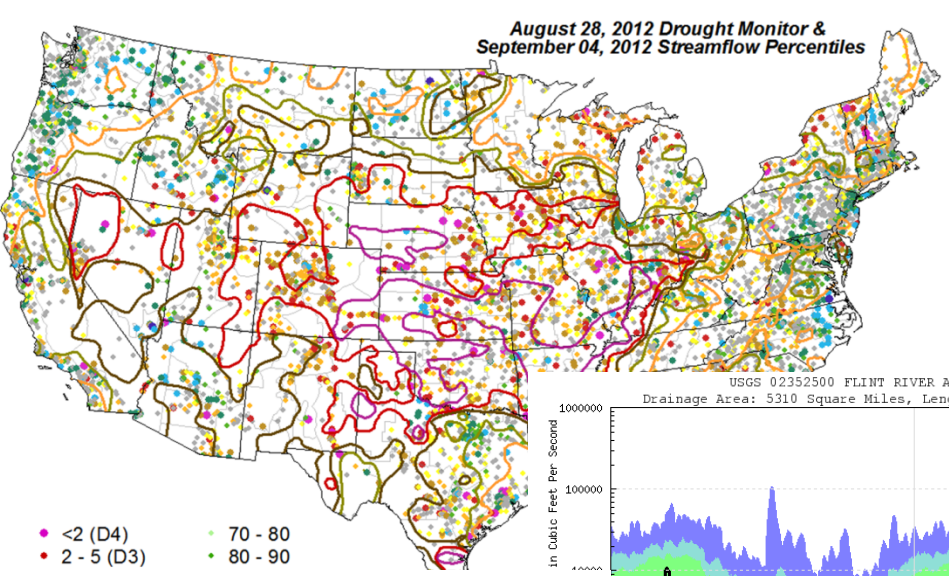


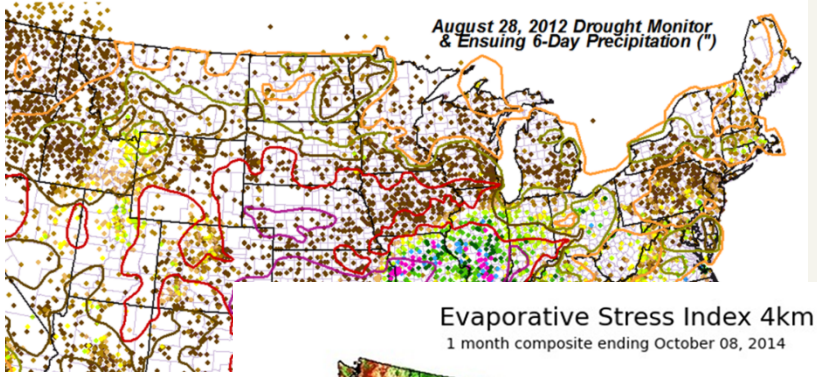


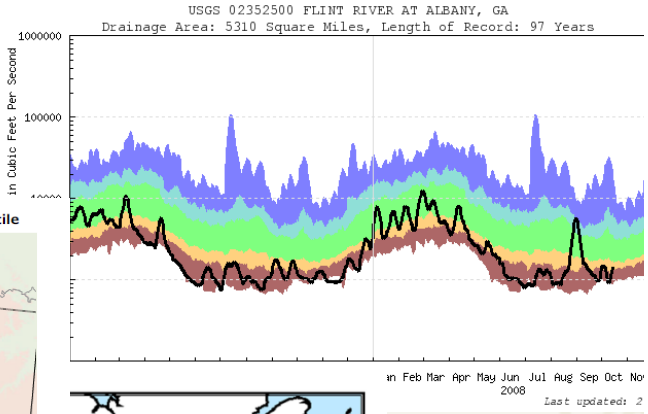


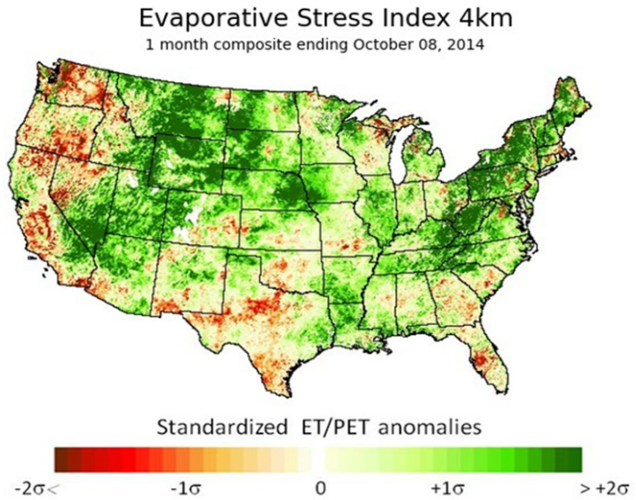


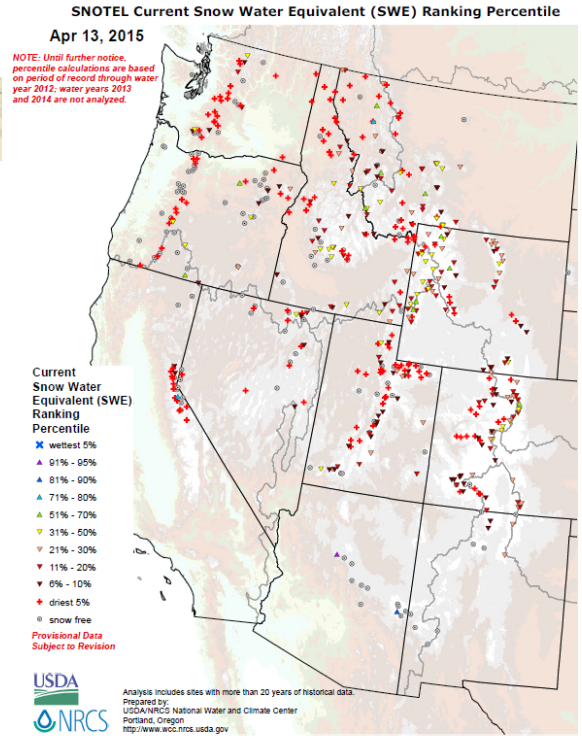
National Drought Mitigation Center

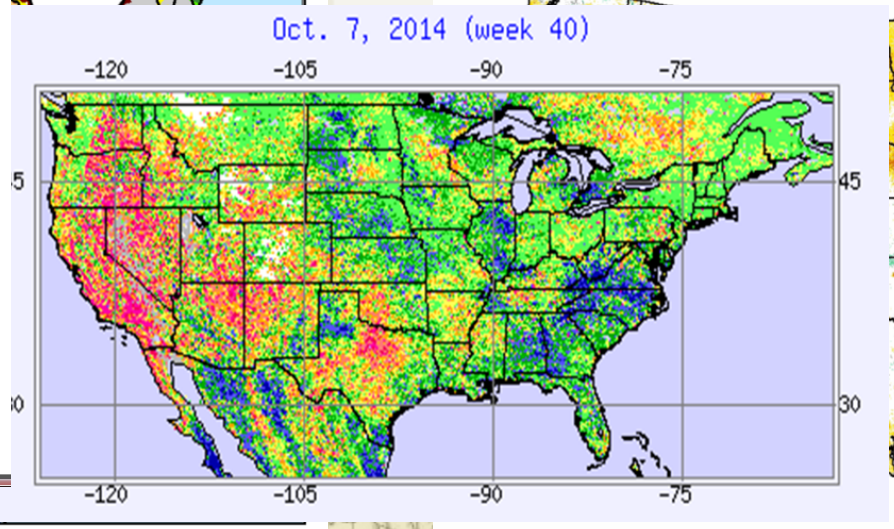

August 28, 2012 Drought Monitor &
September 04, 2012 Streamflow Percentiles
<2 (D4)
2 - 5 (D3)
70 - 80
80 - 90

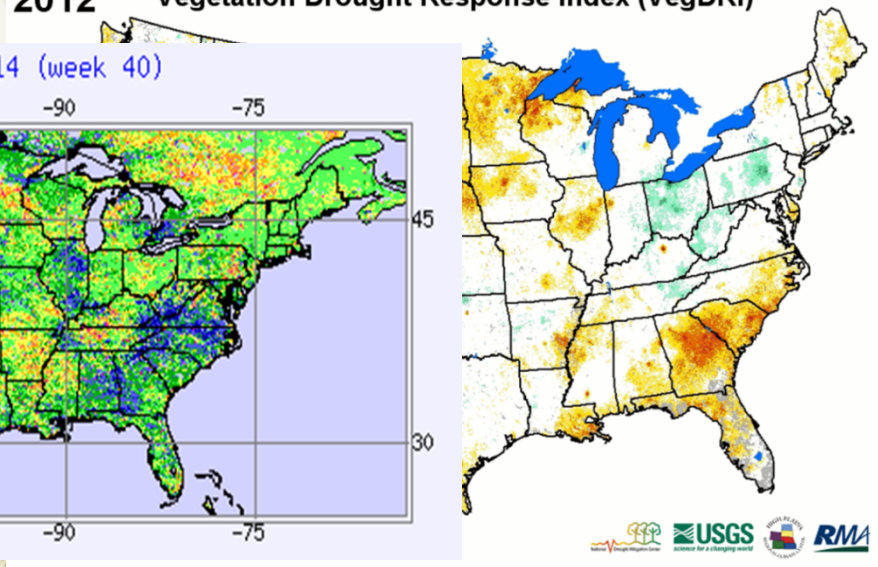

August 28, 2012 Drought Monitor
& Ensuing 6-Day Precipitation (")


USGS 02352500 FLINT RIVER AT ALBANY, GA
Drainage Area: 5310 Square Miles, Length of Record: 97 Years
in Cubic Feet Per Second
1000000
100000
Feb Mar Apr May Jun Jul Aug Sep Oct
2008
Last updated:


Evaporative Stress Index 4km
1 month composite ending October 08, 2014
Standardized ET/PET anomalies
-2σ<
-1σ
0
+1σ
> +2σ


SNOTEL Current Snow Water Equivalent (SWE) Ranking Percentile
Apr 13, 2015
NOTE: Until further notice, percentile calculations are based on period of record through water year 2012; water years 2013 and 2014 are not analyzed.
Current Snow Water Equivalent (SWE) Ranking Percentile
wettest 5%
91% - 95%
81% - 90%
71% - 80%
51% - 70%
31% - 50%
21% - 30%
11% - 20%
6% - 10%
driest 5%
snow free
Provisional Data Subject to Revision
USDA NRCS
Analysis includes sites with more than 20 years of historical data.
Prepared by:
USDA/NRCS National Water and Climate Center
Portland, Oregon
http://www.wcc.nrcs.usda.gov

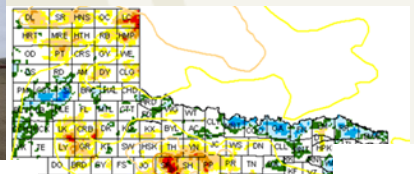

Oct. 7, 2014 (week 40)
-120
-105
-90
-75
45
30

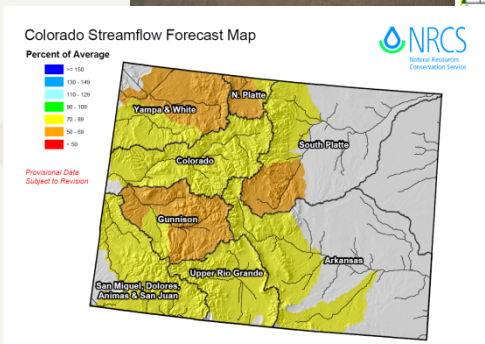

2012 Vegetation Drought Response Index (VegDRI)
USGS
RMA

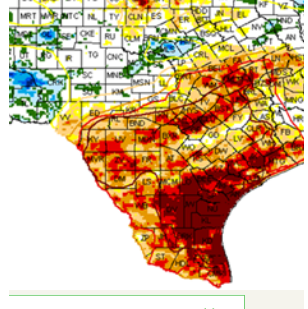
The Importance of Local Expert Input

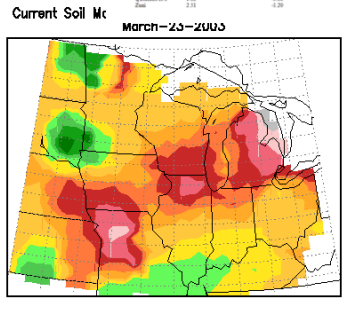
- **The U.S. Drought Monitor Team Relies on Field Observation Feedback from the Local Experts for Impacts Information & "Ground Truth"**
  - ***Listserver (360+ Participants: 2/3 Federal, 1/3 State/Univ.)***

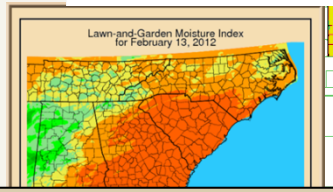
- **Local NWS & USDA Offices**
- **State Climate Offices**
- **State Drought Task Forces**
- **University Extension**
- **Regional Climate Centers**
- **NIDIS Basin Webinars**

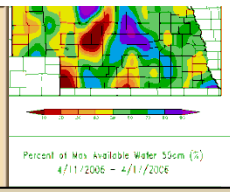


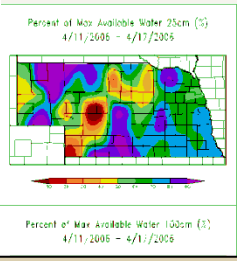


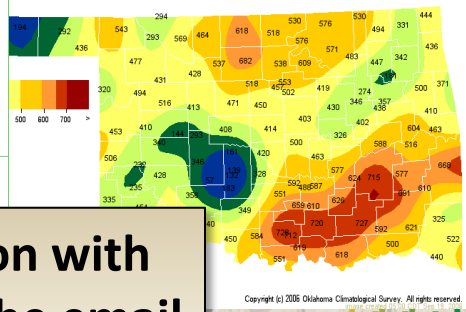












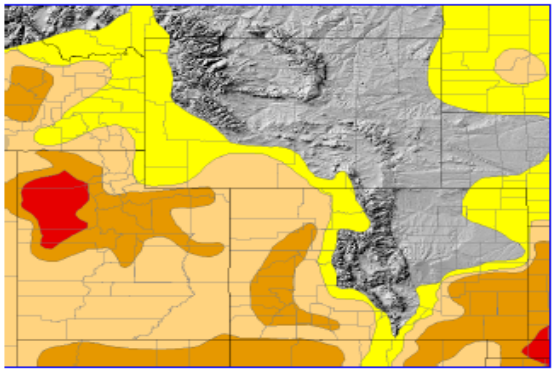
The primary means of communication with our "eyes in the field" is thru email; The email "Expert Group" is called the *USDM Listserver*

National Drought Mitigation Center

Local Input

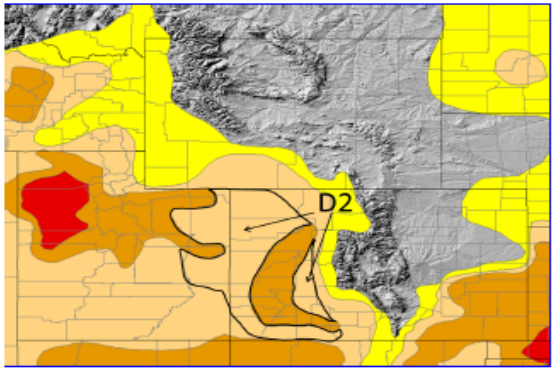
4/1/2015 NIDIS Drought and Water Assessment

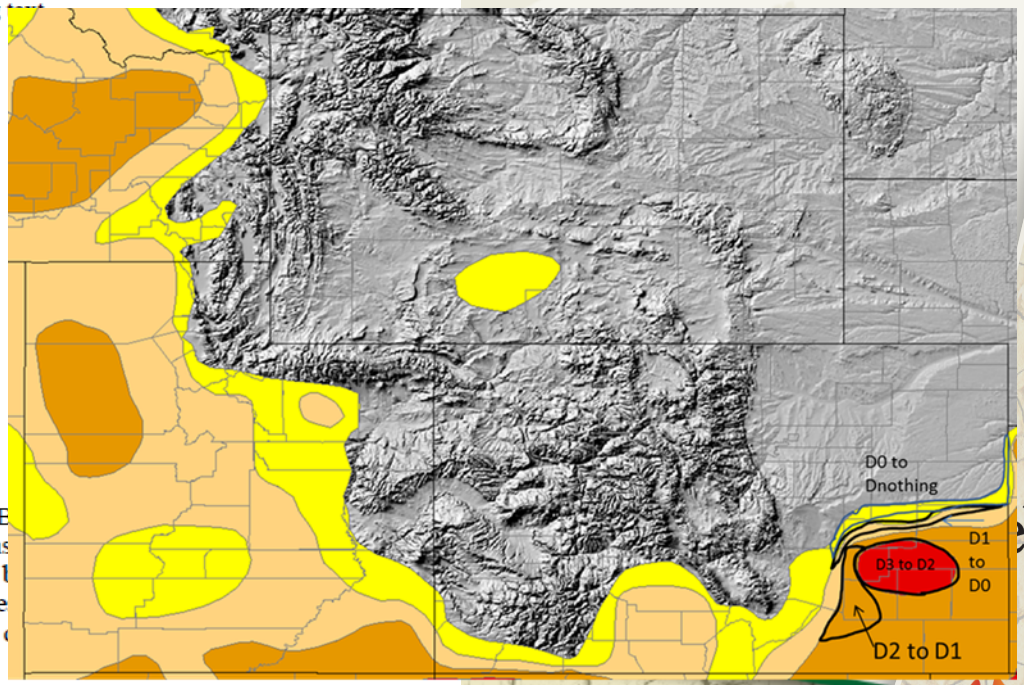
U.S. DROUGHT MONITOR



Drought – Exceptional	0 to 2 (D4)
Drought – Extreme	2 to 5 (D3)
Drought – Severe	5 to 10 (D2)
Drought – Moderate	10 to 20 (D1)
Abnormally Dry	20 to 30 (D0)

Above is the most recent release of the U.S. Drought Monitor map for the UCRB region.
Below shows the proposed changes for this week, with supporting text





Summary for March 31, 2015:

Once again, another dry and warm week over the UCRB
snowpack numbers, precipitation percentiles and increas
around the region. Even though short term SPI's in the
widespread severe dryness, the low SNOTEL percentile
and high temperatures are having an impact in the high
longer term SPI's show more dryness as well.

Due to the current state of snowpack and persistent warm temperatures across the region, more degradations will be suggested in the UCRB.

Local Input

Recommend changes for Far North East CA, and Far NE NV. See attached graphic.

Any errors are mine. Please send any corrections to everyone.

Next call: April 20th, 1PM.

California

MFR: Far NE CA, Modoc County, wells are drying up, so they are having to dig wells deeper. Residential area is being threatened. Runoff is weeks ahead of normal for both Siskiyou and Modoc Counties. **DM Action:** After group discussion - move All of Lassen County and Modoc county into D4. See attached graphic.

Oregon State Climatologist: xx

Eureka: Since October 1, 2014, rainfall departure form normal: Del Norte County 70 to 80% of normal; Humboldt County 80 to 90% of normal; Western Mendocino County 80 to 100% of normal;Eastern Mendocino County 70 to 90% of normal. Precipitation amounts since October 1…below normal, Lake Mendocino, 52% of capacity or around 76% of historical average for this time of year. Storage trending downward from last month. Trinity Lake - 49% of capacity or around 64% of historical for this time of year. Slight increase from February. Activities: (Include OES calls, Drought Task Force calls or meetings), Continue to monitor. After Governor Brown's executive order, most drought media calls going to the local water agencies. Not aware of any new impacts. **DM Action:** Recommend no change for now

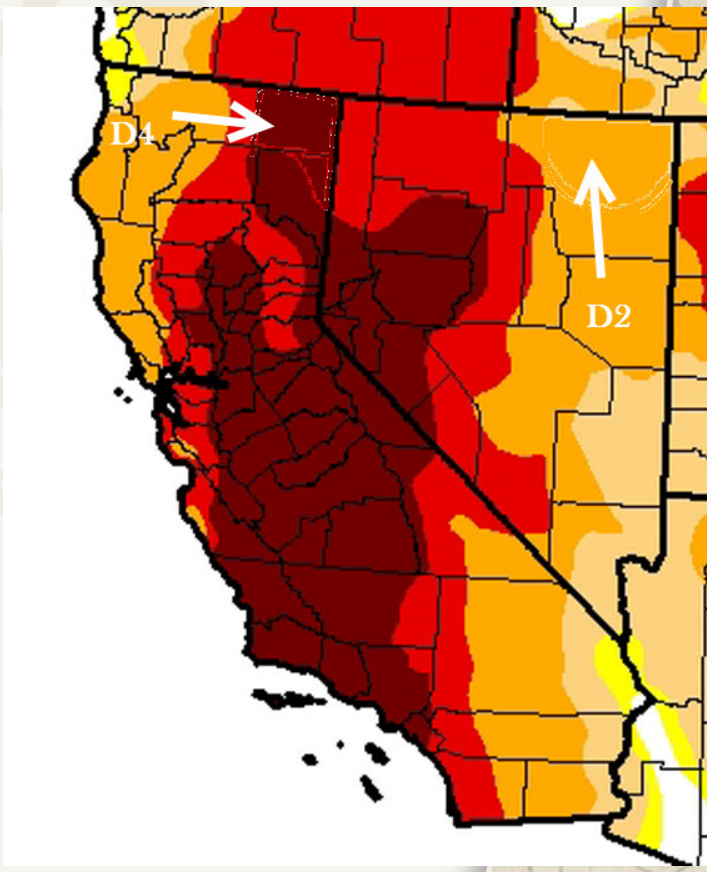
Monterey: Recent rains of .2-.4" in the Northe and East Bay. South Bay received very little to nothing. North Bay reservoirs and those with interbasin transfers are ok to well, those which are fed solely by local runoff are doing poorly. **DM Action:** Hold status quo. No change

Los Angeles/Oxnard: No rain, above average temperatures a wind. **DM Action:** Leave things as is.

San Diego: Record warmth for last 18 months. Just past March was #1 warmest, and February #2 warmest. Precip at 40-60% of normal, and 20-40% in the deserts. San Diego Reservoirs at 40% of capacity. Diamond Vally at 50% of capacity (down to 2010 levels) **DM Action:** No change.

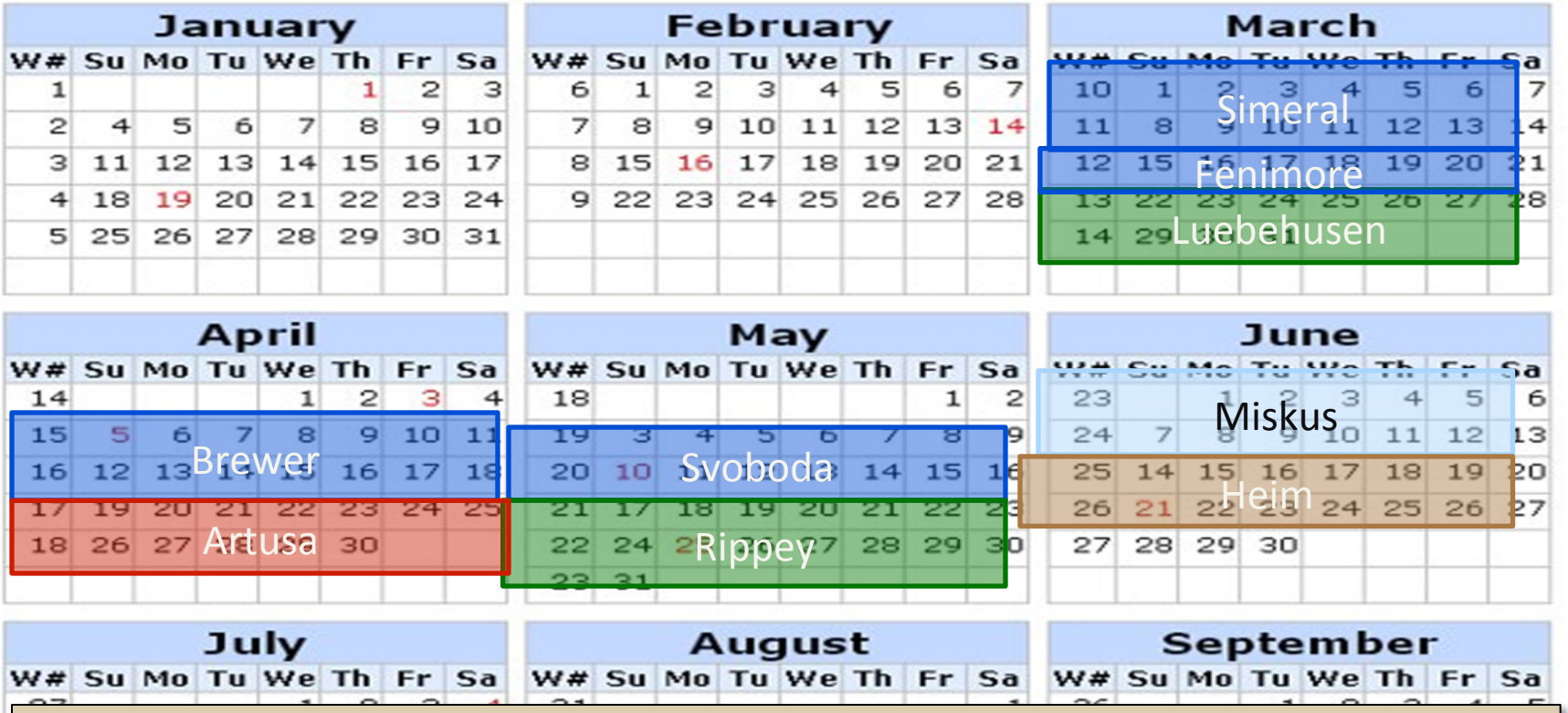
Phoenix: SE CA 20-40% of normal precip for the water year, which is not uncommon fore the desert. Cal Fire has issued a no burn order for all state lands of San Diego and Imperial Counties. **DM Action:** No change

Sacramento: Drought Activities and media interactions continue. We're doing multiple Drought Task Force meeting briefings each month. Last week Governor Brown's announcement of 25% mandatory reductions is causing a stir, but mostly in the 'how do we/they implement this' way. Impacts reported earlier in the year are still continuing. Newest: using some of the drought



Timeline

2015

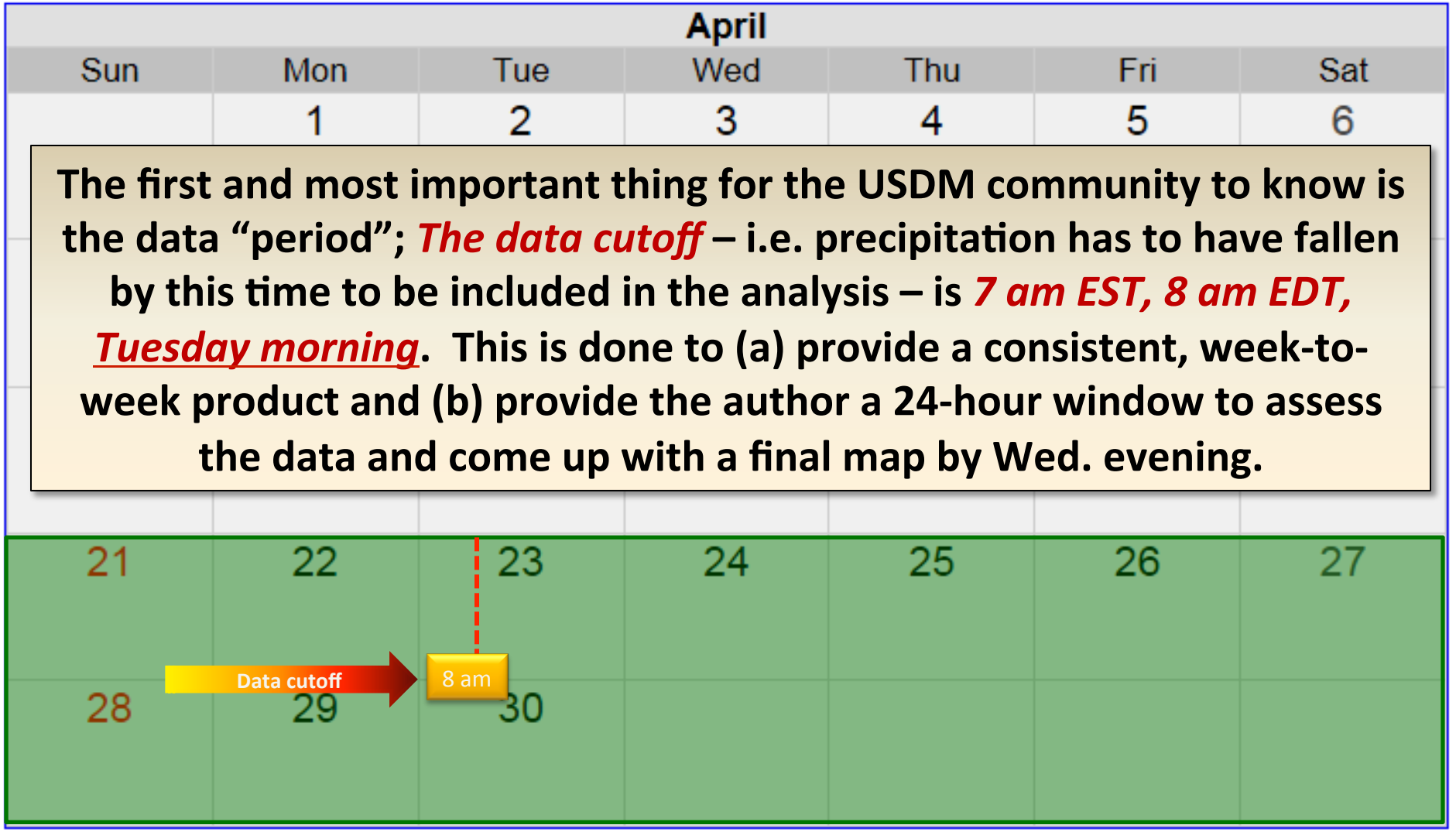


The authors usually takes 2-week turns, although cases arise where they do a 1-week or 3-week shift.

The reason: After two weeks, you are spent.

Each author typically has two 2-week shifts per year.

Calendar for April 2013 (United States)



The first and most important thing for the USDM community to know is the data "period"; *The data cutoff* – i.e. precipitation has to have fallen by this time to be included in the analysis – is *7 am EST, 8 am EDT, Tuesday morning*. This is done to (a) provide a consistent, week-to-week product and (b) provide the author a 24-hour window to assess the data and come up with a final map by Wed. evening.

National Drought Mitigation Center

So just how does the USDM get edited/created every week?

April

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17		19	20
21	22	23	24			25
28	29	30				

Draft 1

Draft 2

Draft 3

Final Map

Final Files Sent

Data cutoff

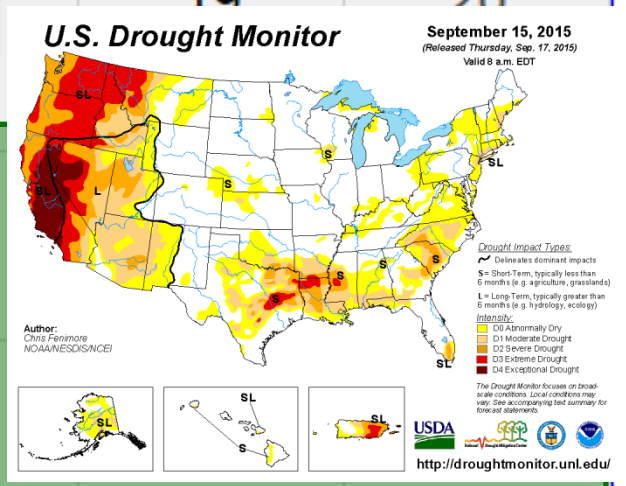
8 am

Input cutoff

2 pm

8:30 am

http://droughtmonitor.unl.edu/



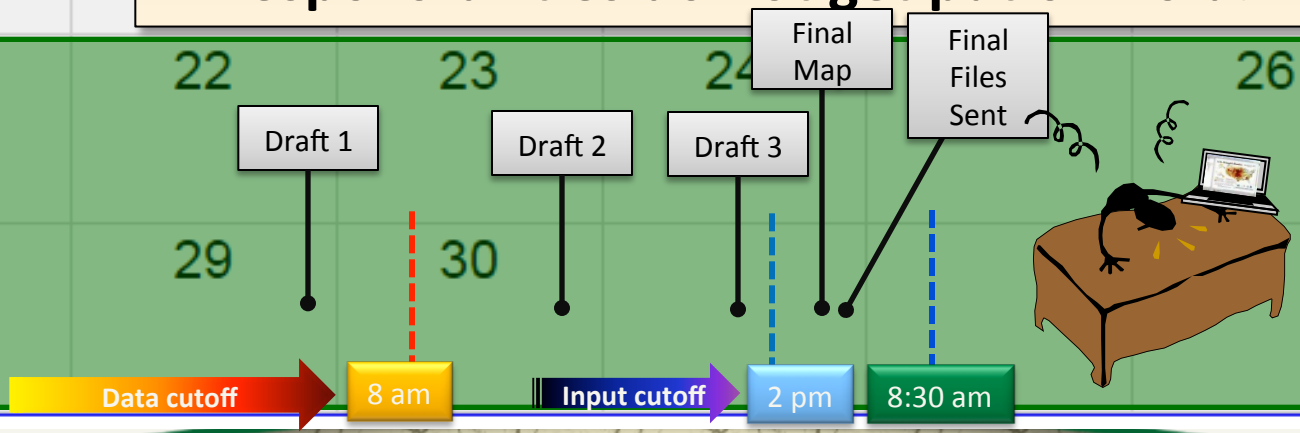
On Thursday, at 8:30 am, ET, the USDM Map and Narrative are released on the NDMC website

April

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5	6
7						13
14						20
21	22	23	24		26	27
28	29	30				

The wash, rinse, repeat: the cycle continues the following week.

Keep in mind the author's primary job responsibilities do not get put on hold.



Critical Elements of the USDM Process

- Started *simple* and built over time
- *Flexible* and adaptable to new data/ products as they come on-line
- Collaboration: It's about the *Process*!
  - *Sharing* the data, products, impacts and credit
- *"Convergence of Evidence"*
- Communication
  - *Transparency and Trust*
- Involving *local experts,* data and feedback
  - Building an *ownership and validation* process
  - *"Value added"* knowledge taps into local expertise

POLICY

Some Examples of Decision Making and Policy Using the USDM

(Science before Policy)

- ***Policy*:**
  - **2008/2014 Farm Bill**
    - **USDA Farm Service Agency, Natural Resources Conservation Service, Risk Management Agency**
  - **Internal Revenue Service**
    - **Livestock tax deferral program**
  - **U.S. Department of Agriculture**
    - **Secretarial *"Fast Track"* Drought Designations**
  - **NOAA National Weather Service**
    - **Drought Information Statements**
  - **Environmental Protection Agency**
    - **Water quality monitoring**
  - **Centers for Disease Control and Prevention**
    - **Public health**
  - **Bureau of Land Management**
  - **Several States use in their monitoring/plans**

Next Steps

- **Continue and grow *interactions* with local drought task forces, State Climate Offices, WFOs/RFCs, Regional Climate Centers**
  - **Foster new basin/state interactions**
  - **NIDIS RDEWS basin briefings…more coming**
    - **S.Plains/California/MO Basin/Carolinas/PacNW-Columbia/ others??**
  - **USDM 101 (User's Guide)**
- **Continue to encourage and incorporate *new/enhanced/innovative products via GIS*:**
  - **ACIS gridded SPI-SPEI/sc-PDSI**
  - **Gridded Objective Indice Blends/high resolution/region-season specific**
  - **AHPS Precipitation from National Weather Service**
  - **Augment with remote sensing products (ET-based: ESI, EDDI)**
  - **NLDAS, Composite Drought Indices, Soil Moisture**

NIDIS

University of Nebraska Lincoln

National Drought Mitigation Center

Questions?

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402-472-8238

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National Drought Mitigation Center
School of Natural Resources
University of Nebraska-Lincoln

Photo Credit: Daniel Griffin